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ABSTRACT

Western European governments have expressed concern over the impact of technological change on employment and appropriate policies and programs to facilitate labor market adjustment. Sweden, Great Britain, and the Federal Republic of Germany are among the most active countries in examining the issue and developing programs to respond to it. National strategies for addressing employment-related problems arising from technological change vary. Sweden is concerned about societal impacts, receptivity to anticipating technological change, and facilitation of labor market adjustment. Great Britain recognizes the need for the broad adoption of new technologies but does not appear to have a major national strategy for anticipating impacts. Germany's strategy centers on national programs to promote the diffusion of microelectronics and computer technologies and to monitor impacts. Sweden's innovative programs for dealing with technological change include computer training and funding for industry's and labor's development of innovative training approaches. Programs in Great Britain include one to encourage industrial applications of and training in microelectronics and periodic surveying of industrial diffusion of computer-based technology. Germany has an extensive program to promote information technology through computer education and pilot projects for retraining. Common problems include worker dislocation, computer training of the future work force, workers with inappropriate skills, new technology introduction with minimal labor market impacts, training of the managerial work force, and monitoring impacts. (YLB)

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TECHNOLOGICAL CHANGE AND EMPLOYMENT IN WESTERN EUROPE

By

Louis Helion Blair

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PREFACE

This report analyzes Western European responses to the new, computer-based technologies. Two of its major findings are that many technology-related issues cross national boundaries, and that governmental and private sector responses to similar issues often vary. Differing national perceptions of how the equipment will affect the labor market, and differing attitudes toward change in general and technological change in particular, influence the nature and scope of national policies and programs.

The author, Louis Hélion Blair, is a consultant to the Organisation for Economic Cooperation and Development (OECD) in Paris. He was, therefore, extremely well-placed to meet with governmental and nongovernmental organizations in the three countries examined in detail in this report (Great Britain, Sweden and Federal Republic of Germany) as well as to collect and summarize material on other Western European countries.

The international perspective of this report complements an earlier Commission-sponsored study by Professor John James, which lends an historical perspective to the Commission's project on the employment effects of computers. Other Research Reports resulting from this project examine how computers are integrated into specific occupations and how they are likely to affect the number and types of jobs that will exist over the next ten years, the extent to which youth and adults are likely to have the necessary education and training that must accompany the widespread introduction of computers into the workplace, and the uses of computers in public schools.

The project and its series of reports were designed by Carol Jusenius Romero, Sara B. Toye, and Stephen E. Baldwin of the Commission staff, who are also supervising all aspects of the project. This team worked closely with the author in the development of this report. It should be emphasized, however, that the information presented, and the issues discussed, are solely the responsibility of Mr. Blair and do not necessarily reflect the views of the Commission or its staff.

The Commission expresses its appreciation to Mr. Blair for his work in collecting and organizing a broad array of information and for his thorough examination of the issues.

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EXECUTIVE SUMMARY

There is widespread concern among Western European governments and some international organizations over the impacts of technological change on employment. There is also concern about appropriate policies and programs to facilitate labor market adjustment to technological change. In short, there is concern about what is frequently referred to as the issue of technology and employment. Technological change is generally thought to be associated with the widespread application of microelectronics and computer-based technologies, especially in the manufacturing sector.

The concern appears to be particularly strong because of several conditions which seem more prevalent in Western Europe than in the United States: generally high unemployment rates (10.7% for the European Economic Community compared to 7.1% for the U.S. at the end of 1984), a high degree of social concern for the welfare of the labor force, and the extensive political influence of organized labor.

The governments of Belgium, France, the Federal Republic of Germany, Great Britain, Italy, Spain and Sweden are actively involved in assessing the impacts of technological change on employment and in developing policies to respond to these impacts. Denmark and Finland have conducted substantial exercises in recent years to develop government policies to deal with the impacts of technological change on the labor market.

A number of international organizations in Europe have examined the issue in detail. The Commission of the European Communities has conducted several studies over the years on the topic through its Forecasting and Assessment in Science and Technology (FAST) program and is currently in the middle of an extensive four-year effort to examine the issue.

The Organisation for Economic Cooperation and Development (OECD) is examining many aspects of the issue and has recently completed a synthesis of findings from studies conducted by twelve member countries and by several international organizations. The OECD synthesis concluded that the new technologies, although not yet widely applied, have had a small positive effect on overall employment. In the manufacturing sector, there has been a relatively slight decline in employment. In the services sector, the new technologies have led to an expansion of jobs, offsetting the number of job losses in the manufacturing sector, though a number of other factors have contributed to this job growth.

The issue has been a popular topic for Ministerial level meetings. In 1984, the OECD sponsored a Conference on Employment Growth in the Context of Structural Change, examining technological advancement as one element in structural change. In April 1985, the Italian Government hosted a Ministerial-level conference on Technology and Employment with participation from the U.S. Secretary of Commerce and the Science and Technology Adviser to the President and high ranking representatives from other OECD Member countries. In January

1986, the Spanish government, with secretarial support from the Council of Europe, will host the Third Conference of European Ministers of Labour. One of the three main themes of the Conference will be "Scientific and Technical Developments and Their Effects on Employment and Working Conditions." These Ministerial-level conferences seem to heighten the interest in, and attention to, the issue in each of the participating European countries.

Sweden, Great Britain, and the Federal Republic of Germany (Germany) were visited to determine how these three countries view the issue of technology and employment, the extent to which they have assessed current and future employment impacts of technology, and the major ways in which they are responding to the issue. These three countries were selected because they have examined the issue extensively, because they provide a broad spectrum of political and social attitudes to technology and employment, and because they are responding in a variety of innovative ways.

Technological change has caused some direct job loss in those industries applying it, but the countries have found it extremely difficult to isolate the extent of job loss due to the introduction of new technologies from those due to structural change, general economic weakness throughout much of Europe, and changing market conditions and competitive relationships. Recent surveys suggest that, at least in Germany and Great Britain, the extent of loss in the manufacturing sector due to the application of microelectronics technologies has been relatively slight, compared to losses associated with other factors. Job losses occurred most frequently in mechanical engineering, metal goods, chemicals and vehicle construction. Technological change has significantly affected job requirements and demands for semi-skilled and low level clerical workers in the three countries.

The present extent of utilization of the new technologies is considered to be small, compared to its potential applications and the expected continuing rapid rate of technological advancement. The impacts are expected to grow as the technologies become more broadly diffused and deployed in a much wider range of ways. The net employment impacts throughout these economies appear almost impossible to predict reliably.

The extent of job loss and the impacts on employment levels, skill demands and the nature of work are believed to be significantly influenced by the ways in which management trains its labor force for the new technologies and introduces and utilizes those technologies. Technological change need not automatically result either in lowering the level of skill required or in substantial job loss in those industries, though much of the workforce will have to develop new skills to meet changing job demands.

There was general agreement that a rapid rate of adoption and diffusion of the new technologies was essential for supporting economic growth and for securing employment for a substantial proportion of the workforce. "You have to play the game of adopting technology rapidly, even if it results in some direct job loss." None of these countries has taken actions intentionally designed to impede or moderate the rate of diffusion of new technologies.

National strategies for addressing employment-related problems arising from technological change varied:

> Sweden appears to devote the most attention to minimizing adverse labor market impacts of technological change, exhibiting a high degree of cooperation among government, labor and industry on assessing the likely impacts of technology, on developing policies and programs to promote a smooth transition to an economy heavily reliant on computer-based equipment and processes, and on efforts to assure that virtually all of the population has some computer skills.
>
> Great Britain, although making some noteworthy efforts to monitor impacts and some specific efforts to promote technology diffusion, does not appear to have a major national strategy for preparing the skilled, semi-skilled and unskilled portion of the workforce for technological change -- although it does have a high-level commission developing recommendations to assure that there be no shortage of managers and engineers to impede the diffusion of computer-based technologies.
>
> Germany's strategy centers on substantial national government programs to promote the diffusion of microelectronics and computer and communications technologies and to monitor impacts. The government relies heavily on industrial apprenticeship programs to train the emerging labor force to use and cope with the new technologies and has adopted legislation providing for early retirement or a shorter workweek to cope with some of the problems associated with employment-displacing effects of technologies.

All three countries have innovative programs for dealing with technological change, either to assist labor market adjustment or to promote technological diffusion, in part as a means of securing employment. Programs of potential interest to the United States are:

> Sweden: Extensive efforts to train the workforce and the population at large on the uses and applications of computers; two experimental programs providing government funds for industry and labor to attempt innovative approaches for training the workforce to use the new technologies and for introducing the technologies with minimum adverse impacts; and the Renewal Fund in which 10% of the 1984 profits of individual companies have been set aside for labor and management to decide jointly how the funds will be used for research or training to enhance corporate performance and to promote more secure employment of the company's workforce. The Parliament was considering an extensive array of programs recommended by a commission that spent six years examining the issue of the impacts of computers on employment and society; one of the proposals would reserve special public funds for education and training of persons currently employed in industries judged by the National Labour Market Board as likely to contract.

Great Britain: The Government's Microelectronics Application Project to encourage widespread industrial applications of microelectronics and to provide a wide variety of training courses for engineers and technicians; the Information Technology Skills Shortage Committee, which is trying to develop a joint educational- community-industry program to meet industry's professional and technical manpower needs in computers and information technologies; a periodic surveying activity to track the rate of industrial diffusion of computer-based technology and the direct employment impacts of the adoption of computer-based manufacturing technologies on jobs in the manufacturing sector; the Work Research Unit which conducts research on a variety of labor management aspects of technology, especially those related to the introduction of new technologies.

Germany: An extensive national program to promote information technology that calls for widespread computer-related education of the emerging workforce and pilot projects to develop vocational retraining mechanisms for the existing workforce; development of a methodology for assessing the impacts of technology; jobs-qualification study to determine the impacts of technology on skill demands; the Humanization of Work program to conduct research and support pilot projects to reduce the adverse impacts of the introduction of new technologies in the workplace.

There were common problems faced by the three countries which appear similar to those perceived in the United States and where cooperative research and sharing of experiences would seem appropriate.

Mid-career blue collar workers threatened with dislocation: How to provide training to persons in industries or corporations likely to shrink and where there is no corporate/industry incentive or ability to retrain the workers;

Computer-related training of the future workforce: All three countries recognize that substantial modifications are needed in the upper and lower secondary education systems for students receiving general training and vocational training, but no consensus has as yet appeared on the types of training needed;

Gap between unemployed and unfilled positions: Some of the persons interviewed anticipate increases in both the number of persons unemployed and the number of vacant jobs because of a shortage of people with appropriate skills;

Ways to introduce new technologies to minimize their labor market impacts. Industries have used a variety of approaches to minimize the impacts of the introduction of new technologies. Interest was expressed in an identification and evaluation of these programs;

Training of the managerial workforce. The labor market impacts of new technologies as well as their corporate success depend heavily upon the skills of the management force in industry. There might be incentives or support that governments can provide to upgrade management training/retraining.

Methodological problems in monitoring impacts: There are substantial problems both in terms of how to assess the impacts to date of the technology on employment and job qualifications. Projections to help anticipate problems are even more difficult.

AN OVERVIEW OF WESTERN EUROPE

There is widespread concern among Western European governments and some international organizations over the impacts of technological change on employment. There is also concern about appropriate policies and programs to facilitate labor market adjustment to technological change. In short, there is concern about what is frequently referred to as the issue of technology and employment. Technological change is generally thought to be associated with the widespread application of microelectronics and computer-based technologies, especially in the manufacturing sector. It is also considered to involve biotechnology and new materials, but the short- and medium-term employment impacts of these technologies are expected to be relatively small in comparison to those others.

This concern about the employment impacts of technological change appears to be particularly strong because of several conditions which seem more prevalent in Western Europe than in the United States: a high degree of social concern for the welfare of the labor force, the extensive political influence of organized labor, and generally high unemployment rates. At the end of 1984 the standardized unemployment rate in the European Economic Community was 10.7% compared to 7.1% for the U.S.(1).

The governments of many Western European countries are actively examining or have completed recent examinations of the effect on employment of technological change. Sweden, Great Britain and the Federal Republic of Germany (Germany), among the most active countries in examining the issue and developing programs to respond to it, are discussed in succeeding chapters. This chapter briefly summarizes activities of some other countries and of several of the international organizations which are examining the issue.

In March 1985, the Belgian government established a high-level interdepartmental task force to examine employment effects of technological change and to make recommendations on Government responses to aid labor market adjustment to technological change. At the time this report was prepared, the Task Force had not decided on its specific activities.

In France, the Ministry of Industry and Research is examining effects of technological change on employment through its Programme Mobilisation Technologie Emploie (essentially a program to promote employment through technology) and through the Center for Planning and Evaluation. France participated in a survey of industries to estimate the direct employment impacts that the adoption of computer-based technologies had on manufacturing. Between 1981 and 1983, these technologies are estimated to have resulted in the creation of 13,000 new jobs and the loss of 25,000 jobs for a net loss in all factories in France of 12,000 jobs. The most severe job losses occurred in textiles, food and drink, and metal goods (2).

At the 1984 London Economic Summit Meeting of the Major Industrialized Western Countries, the member countries accepted an invitation from the Italian Government for a Ministerial-level conference to be held in April 1985 in Venice on the subject of technological innovation and the creation of new

jobs. The conference concentrated on four subjects: the effects of technological change on employment and the creation of new jobs; policies for supporting technological innovation; social measures to reduce the costs of transition; and the formation of human capital (3). The Secretary of Commerce and the Science and Technology Adviser to the President represented the U.S. at the Conference.

In Finland, the Council of State established the Finnish Technology Committee in 1979 to review the state of technological development and especially automation, to estimate its probable effects on competitiveness of Finnish industry and on employment and working environments, and to prepare proposals to diminish the detrimental effects of automation technology. In its final report, the Committee proposed that the fundamentals of the new computer-based technologies be taught to all age groups, beginning in secondary schools, and that efforts be increased for research and technology transfer in this field (4).

The Government of Denmark established a commission to examine the impacts of technological change on various sectors of the economy, including agriculture. Reports were published in 1983 and 1984. Unfortunately for the author of this paper, they were in Danish.

In January 1986, the Government of Spain will host the Third Conference of European Ministers of Labour (last meeting in 1983) where one of the three main themes is to be "Scientific and Technical Developments and Their Effects on Employment and Working Conditions." The Council of Europe (CE), an international organization based in Strasbourg, France and representing 21 democratic countries of Western Europe, is serving as the secretariat for the meeting, aided by a committee of senior officials from member countries. The issues to be discussed have not been finalized but are likely to center on adaptive measures to assist governments in responding to the employment-related impacts of technological change.

In conjunction with the preparation for this Ministerial meeting, the CE commissioned the preparation of a paper on the effects of scientific and technological developments on employment and working conditions (5). The paper examined the effects of new technologies, especially the computer-based ones, on the level of employment, on women's employment, on skills and occupations, on working conditions, and on implications for industrial relations. The paper concluded that technology will be a major cause of job dislocation and that 30 to 40 percent of all economic activity will be affected; that the education and training system will have to be changed to stress the transmission of communications skills, problem-solving abilities and familiarity with computers and related equipment; that governments and industry will have to take active measures to assure that women have access to training programs to enter new sectors of economic activity; and that the countries that move most rapidly to apply the new technologies will gain a competitive advantage in international markets and will be able to protect employment opportunities better than countries that lag in their adoption.

The Commission of the European Communities (CEC) in Brussells, a part of the now twelve-member European Economic Community, has operated the

Forecasting and Assessment in Science and Technology (FAST) program since the early 1980's. FAST has supported research and published more than twenty research reports dealing with the issue of technology and employment (6). The FAST work program for 1984-87 is examining in detail the relationships among technology, work, and employment and is carrying out research in nine activities including the "brainworkers" and robots and production systems (7).

The CEC prepared a summary paper on technological change and social adjustment (8). The paper noted that in Europe, computer-based equipment could result in the direct loss of 160,000 to 400,000 jobs in the metalworking and mechanical engineering industry by 1995 and that many other sectors of the economy such as chemicals, textiles and clothing, and pharmaceuticals could also suffer employment declines. It also noted that new technologies could lead to the development of new products and services resulting in anywhere from four to five million new jobs by 1995. The report highlighted the employment problems of the more disadvantaged groups: young people and women, especially those with few qualifications; migrant workers; and older workers. The report stated that the social change brought about by technological progress calls for a fundamental rethinking of the place and nature of both initial and continuous training of the workforce without specifying what should be the new types of training.

The Organisation for Economic Cooperation and Development (OECD) has devoted considerable attention to the issue of technology and employment. In 1984 OECD held the Ministerial Level Conference on Employment Growth in the Context of Structural Change, examining in one session technological advancement as an element of structural change (9). On-going and recently completed work within OECD relating to technology and employment has been summarized in a background paper for the Italian Ministerial conference mentioned above (10).

Probably the most relevant work by OECD on the issue was conducted for its Working Party on the Assessment of Societal Impacts of Technology. The Secretariat synthesized the findings of studies of this subject carried out by twelve OECD member countries as well as by OECD itself, CEC, and the International Labour Organization (11). The synthesis concluded that the application of the new technologies appears to have had a small positive effect on overall employment. In the manufacturing sector, new technologies have contributed to a relatively slight decline in employment which has been more than offset by the contributions of technology to job growth in the services sector and in high technology industries. The synthesis noted that new technologies affect occupational and skill structures of the labor force by increasing white collar worker demand relative to blue collar workers and the growth in professional, technical and higher management occupations relative to clerical and sales workers.

As for the future, the synthesis pointed out that country studies have developed forecasts which range from little net impact on total employment to potentially large losses of jobs amounting to ten per cent of the workforce. The largest job losses are projected for basic metals, machinery, printing and publishing, and motor vehicles. Industries providing technology-intensive goods and services are projected to increase employment, but not enough to reverse the long-term trend toward declining manufacturing employment.

TECHNOLOGICAL CHANGE AND EMPLOYMENT IN SWEDEN

Overview on Sweden:

Sweden, with a population of about 8.3 million and a workforce of about 4.4 million, of which 30% are employed in the industrial sector compared to 28% for the U.S., is one of the smallest industrialized European countries. Yet Sweden is of particular interest for a number of reasons: it has given a high degree of political attention to the issue of technology and employment and has probably devoted more resources to facilitating labor market adjustment to technological change than any other country in Europe.

Sweden has experienced a high degree of penetration of technology. Data from the OECD show that in 1983 Sweden had the highest rate among Member countries in the use of industrial robots, 2.0 per thousand manufacturing employees compared to 1.46 per thousand for Japan, 0.63 per thousand for the Federal Republic of Germany, 0.43 per thousand for the United States, and 0.32 per thousand for Great Britain (12). Swedish industry has experienced a considerable amount of restructuring, with employment in sectors such as shipbuilding and steel production down to roughly one quarter of the level of 20 years ago. Sweden has a highly favorable reputation in Europe for producing and using advanced technologies such as robots, new telecommunications systems, and precision machining systems among such companies as Volvo and Saab in transportation; ASEA, Electrolux and Ericsson in electronics and telecommunications; and a number of wood product companies.

Finally, the societal attitudes and government approaches for addressing the issue in Sweden are considered to be representative of those throughout Scandinavia.

Special aspects of Sweden:

There are some special, perhaps unique, aspects of the Swedish economy, culture and labor-management relations which appear to contribute to the Swedes' general receptivity to new technologies, even those with labor displacing characteristics. A primary goal of Swedish policymaking since World War II has been the achievement of full employment. The 1985-86 Swedish Budget states that "the restoration of full employment is the primary target for the Government's economic policy. Everyone who wishes to shall be entitled to a meaningful job." The Government has expanded public sector employment to offset job losses in the manufacturing sector. Over the past decade employment growth has been due almost entirely to expansion of the public sector.

A striking aspect of Sweden is the widespread acceptance by the public and by the labor force of the need for the new technologies and the willingness and ability of the labor market to shift to accommodate the changes. One person interviewed attributed this positive attitude to the 40 years of socialism in Sweden, the confidence the workers have in the

Government's and society's ability to care for them in the event of job loss, and the priority given to achieving consensus and building a strong partnership among labor, management and government for any restructuring.

An unemployment rate of 3%, generous unemployment benefits, and extensive paid re-training programs for the unemployed (who are not counted in the unemployment statistics when in such programs) assures the workforce an adequate income (13).

There is a high per capita income -- $14,000 per year, the highest among OECD member countries -- and, according to persons interviewed, a relatively small difference in income between blue collar and managerial workers. This fact contributes to good labor-management relationships and apparently removes any perceived economic threats that workers might be displaced by new technologies to substantially lower-paying jobs requiring fewer skills. There appear to be relatively non-adverserial labor-management relationships. Most of the negotiations between labor and management are centralized, with one industry association representing 85% of Swedish industry and two confederations of labor organizations representing over 80% of the workforce. The groups negotiate annually on salaries, wages, working conditions, training, and so forth. The introduction of technology and the effects of technology on employment, working conditions and jobs are important aspects of these negotiations.

Sweden has strong cultural traditions of worker involvement in determining the issues that affect him. Laws have been enacted and agreements made between organized labor and industry on the ways in which technology is to be introduced into the workplace. Two of particular relevance are:

> Law of Co-determination of 1977, which requires employers to consult with their workers before making and implementing significant changes in the workplace, including the introduction of new technologies, and to share information with the workforce (Laws of co-determination exist in other European countries, for example Germany); and
>
> Development Agreement of 1982, an agreement between the bargaining association representing industry and the two union confederations (representing the white collar and blue collar workers) (14). It provides guidelines for negotiations between employers and the labor force on the ways in which technologies are to be introduced. The employer is required to describe the considerations underlying adoption of the new technology and the anticipated technical, financial and economic, work environment and employment consequences resulting from implementation of the new technology. The employer is encouraged to set up employer-worker project groups to assist the introduction of new technologies in the workplace. Employers acknowledged the need to train workers at company expense for the new positions.

Attention to the issue of technology and employment:

There are or have been several substantial efforts to examine the effects of computer-based technologies on employment and the workplace, including:

Commission on the Effects of Computerization on Employment and Working Environment, appointed by the Minister of Labour in 1978 to investigate and analyze the effects of information and computer technology on employment and on the working environment. It also investigated the education needs resulting from the broad diffusion of computers. It was composed of a broad spectrum of representatives from industry, labor and the major political parties. By the time the final report was published in 1984, the Commission had issued 20 publications (15).

Major recommendations being specifically addressed by the Swedish Parliament in 1985 include:

Labor market training with special funds reserved for the education and training of established employees facing structural change due to the introduction of new technologies. The National Labour Market Board should identify sectors of the economy likely to be affected by extensive structural change and the ways in which employers should provide training. For the emerging labor force still in schools, courses in computer sciences should be stressed, supplemented by vocational training in the application of computer technology;

Special programs directed toward women. The Commission suggested the program contain information diffusion, education activities including local computer training centers exclusively for women, and research about the women's labor market in connection with computerization;

A development program aimed at making computer technology accessible to disabled people;

Regional programs to provide information, advisory services and the exchange of experiences regarding computers and computer applications to potential users; and

"Centers for Administrative Computer Development" to create a high level of quality in the computer services and equipment offered to small companies and businesses.

The Data Policy Committee is a permanent study committee within the government that examines technology and employment issues, analyzes reports prepared by various advisory groups, and provides guidance to the government on a wide range of issues associated with technology. This Committee has taken the findings from the Commission discussed

above, reviewed them, and sent a proposal for actions to implement them to the Parliament. The Committee expects to complete an analysis in the summer of 1985 on the most appropriate methods for educating young people in school to prepare them for a computer-oriented workplace and society.

The Swedish Center for Working Life, an independent research organization with approximately 50 professionals and supported by the Government and labor, has examined various aspects of the impact of technology on the workplace but not specifically the impacts on overall employment. A number of its reports have been translated into English.

Effects of technology on employment and work:

There was little in the way of quantitative data in Sweden on the specific impacts of technology on the levels of employment because of the methodological difficulties in separating the effects of technology from others such as economically-induced structural change, changing markets, and so forth. However, there was general agreement among government and labor officials interviewed on the following two points:

Technology has had a positive effect on employment throughout the economy, but it has been accompanied by a loss of employment in the manufacturing sectors. Automation and other technological advances in manufacturing processes have caused job losses in some industrial sectors such as steel production and electronic components assembly and contributed to "jobless growth" in other sectors, particularly in wood products and pulp and paper. But, in the view of the persons interviewed, this has been more than compensated for by a strengthened economy, by demand in other sectors for employment, and by improved competitiveness of Swedish industries as a result of having the new tools of technology. Manufacturing employment was reported to have declined by about 50% over the past 20 years, but the decline was attributed more to structural changes in the economy and decisions by the government to allow such sectors as steel production and shipbuilding to decline;

Technology has had a disproportionately large employment impact on some groups of workers, especially on semi-skilled and unskilled blue collar workers in the mechanical engineering trades (e.g., assemblers and material handlers) and on lower level clerical jobs. Though statistics were not provided to document it, a representative of the umbrella trade organization for blue collar workers said that a substantial shift in employment has resulted in a large number of blue collar workers taking on white collar jobs and then changing labor organization membership.

Attitudes toward technological change:

The positive attitude toward and acceptance of technological change among organized labor in Sweden was particularly striking. As a representative from the Data Policy Committee put it, "There is no longer a question of whether to have technical change, but rather questions of how, who will participate, what will be the quality of the jobs." According to a representative of the Swedish Confederation of Trade Unions, the attitude of organized labor abruptly shifted in 1981 from reluctance to adopt technological change that had substantial job-displacing characteristics to support for such change. She attributed this change in attitude to the workforce's realization of the need for technological advancement to attain high levels of industrial performance and economic growth and to provide for secure employment and good working conditions. She went on to say, as government officials repeated in separate interviews, that the workers support change because they feel secure that even if technology does lead to the abolition of their positions, there will be employment opportunities elsewhere and adequate state assistance for transitional unemployment periods.

Swedish responses to technological change:

In early 1985 the Swedish Parliament was considering the recommendations discussed above of the Commission on the Effects of Computerization as forwarded by the Data Policy Committee. According to a representative of the Department of Labour, Parliament was likely to act favorably on many, if not all, of the recommendations. If enacted, these new programs would supplement the following programs already in existence.

Education and retraining: Sweden has a considerable array of retraining and education programs to prepare the non-employed portion of the workforce and the emerging workforce for an era of extensive reliance on computer-based equipment. Highlighted programs were:

> Adult education "leisure time" programs. These programs are paid for by the government and can be designed to meet the demands of the clients in terms of content, location and meeting time. They are normally held outside regular working hours. They are open to the public throughout Sweden. The thrust of these programs is to educate the public on the use of computers. About 5% of the adult population has participated in these programs.
>
> Labor market training centers. The Government operates these centers throughout Sweden. Approximately 90% of the clients are unemployed at the time of entry and most of the rest were reported to be employed persons threatened with unemployment due to structural change. The clients are largely youths trying to gain employment or immigrants to Sweden. Approximately 125,000 received training in 1984, with training stressing the use and application of computers. These centers appear to serve roughly one third to one half of the

unemployed seeking employment. (The bulk of the responsibility for re-training and for assuring that currently- employed workers have the new skills required for the new technologies is vested in the employer. There was no information available on the scope, quality, and magnitude of these efforts.)

Pilot program to upgrade low-level clerical workers. In 1984 the Government initiated a pilot program to design and test methods to up-grade 5,000 lower-level clerical workers. Experiments were conducted in four of Sweden's 24 counties on different methods to train clerical workers and to introduce computer systems into the workplace. The experiments were conducted by industry in consultation with organized labor and were to be evaluated in the spring of 1985.

Experimental program for the introduction of new technologies. In 1982 the Government installed a fifty-million kronar (about six million dollars) program, spread over five years, to sponsor experiments in industry to develop good methods and practices for managing the introduction and integration of new technologies into the workplace and determining the best mechanisms for worker retraining to accommodate the changes. Volvo is participating in the program.

There has been substantial concern about computer training in the school systems throughout Sweden. In January 1985, the Government of Stockholm (population less than one million) was considering the purchase of 30,000 computer terminals so that each child in primary school could have his own terminal to learn to use, program and work on the computer with fellow students (16).

Labor market information dissemination/Enhancing the mobility of the workforce: The government has a network of computer terminals throughout the country, tied to a common data bank, listing the unfilled jobs registered throughout the country. The Government provides funds for workforce relocation, paying all moving expenses and a resettlement/start up payment of 15,000 Swedish kronar (about $1600) to help families relocate. According to persons interviewed, the majority of the unemployed portion of the workforce -- especially those where another member of the family is already employed -- has been reluctant to move. (A high proportion of the workforce is composed of working couples; 80% of Swedish women of working age are in the workforce.)

Reduction in the workweek and early retirement as responses to job displacement: This is considered a "defensive measure" or a sort of last resort in Sweden and has not been undertaken as a response to technological change. However, the retirement age has been reduced recently from 67 to 65 as a benefit for the older portion of the workforce.

The Renewal Fund: On January 1, 1985, Sweden began conducting a trial program for one year to upgrade the research base of individual companies and to enhance the skills of their workforce. 10% of the corporate profits from 1984 -- or up to 500,000 Kronar ($55,000) -- from each profitable company has been set aside for the purposes of re-training the workforce within the company or for R&D to develop new processes and products. It is hoped that this fund will lead to improved corporate performance and to increased employment and job security. Management and its labor force jointly decide on the expenditure of the funds.

Improving the working environment in the light of technological change: In 1978 the Swedish Government enacted the Work Environment Act, emphasizing that the working environment should be satisfactory. The Act goes beyond the U.S. concept of occupational safety and health and stipulates that workers be able to influence their work situations. (For example, to make changes to reduce strain and boredom and to be integrated with and not isolated from the rest of the workforce.) As part of this Act, the Work Environment Fund was created to promote research and education on workplace problems. Supported by a tax of 0.096% of all salaries and wages earned, the Fund generates about $70 million per year and is used in part to finance the Swedish Center for Working Life.

Technology diffusion: Sweden has not given high priority to governmental programs targeted at the promotion and rapid diffusion of technology as have Great Britain and Germany. Each of the 24 counties of Sweden has regional development authorities with funds to spend on the promotion of regional development. Some of these funds are used to promote technology as a means of promoting employment growth and economic development. The National Government has made funds available to small concerns to hire consultants to aid them in the process of selecting new technologies, especially data processing/computer systems.

Concluding Observations:

Of the three countries visited, Sweden seems to be the most concerned with the employment effects of technological change and has the most extensive array of programs for aiding labor force adjustment to technological change. If many of the proposals of the Commission on the Effects of Computerization on Employment and Working Environment are adopted, as seems likely, Sweden will probably be by far the world leader in Government efforts to aid labor market adjustment. The high degree of attention paid to technological change and the willingness of the workforce to accept it appear due in large part to the welfare-state political philosophy which has existed in Sweden for the past forty years and the close partnership among industry, labor, and government.

TECHNOLOGICAL CHANGE AND EMPLOYMENT IN GREAT BRITAIN

Overview of Great Britain:

Great Britain, with a population of 56 million and a workforce of 26 million, of which 50% belong to employee unions, has the second largest labor force in Western Europe, only 200,000 less than the Federal Republic of Germany. One third of its workforce is employed in the industrial sector, primarily in manufacturing, but other areas include construction, mining, and electricity, gas and water production and distribution.

Great Britain was selected for examination for several reasons. Its political philosophies about the appropriate roles for government intervention in the labor market and in policies for supporting industrial growth appear closer to those of the United States than of any other Western European country. It has a high unemployment rate (13%, far higher than Germany's of 8% or Sweden's of 3%) and a declining manufacturing sector (some 600,000 to 700,000 jobs reported lost between 1981 and 1983); this would seem to politicize the issue of the impacts of technology on employment. There is a widely expressed view, confirmed by many persons interviewed, that Great Britain needs new technology to modernize and upgrade industrial performance. Great Britain has a good data base on the quantitative impacts of technology on employment in the manufacturing sector.

Special aspects of Great Britain:

There are some special aspects of Great Britain's economy and society which appear to affect concern for, and responses to, the issue of technology and employment. In general, the Conservative government has a "hands-off" attitude towards government intervention in the private sector and a strong desire to extricate itself from nationalized industrial operations. There are stringent economic conditions, not only because of the historically low value of the pound vis-à-vis the dollar and high interest rates, but also a high unemployment rate and generally sluggish economic growth in recent years. Labor-management relationships appear to be strained, and are probably exacerbated by the fact that the Labour party is in the opposition and does not have control of Parliament and strongly disagrees with the Conservative government on the best approaches for dealing with the problems of an aging industrial stock and high unemployment rates.

Attention to the issue of the impacts of technology on employment:

The issue of the impacts of technology on employment does not seem to be of as much concern in Great Britain as in Sweden and Germany. A representative of the umbrella trade union federation considered technological change about the tenth most important labor management relations issue after such others as pay, benefits, job security and the like. Still, the Government

and some private groups have given significant attention to monitoring the issue and the best set of quantitative data on impacts was found in Great Britain.

One of the most interesting and extensive efforts to study the issue in any of the European countries with which the author is familiar is being conducted by the Policy Studies Institute (PSI), a private policy research institution. PSI has developed a survey questionnaire for interviewing manufacturing companies to determine the extent of corporate use of microelectronics in production processes and the extent of job loss or job gain directly associated with the application of microelectronics. With support from the Department of Trade and Industry and from private sources, PSI has been able to conduct two surveys, one in 1981 and one in 1983 (17). For each survey, 1,200 firms were interviewed by telephone. PSI is conducting a third survey in 1985 with published results likely before the end of the year. PSI has recently completed an extensive report entitled "Microelectronics and Industry: An International Comparison: Britain, Germany, France" in which the degree of diffusion and the estimated employment impacts of such diffusion have been estimated from interviews in more than 3,800 factories in the three countries (18). (The Industry Committee of the OECD has initiated a project in which PSI or some other organization using a similar instrument is likely to be making comparable surveys in other countries, providing some of the best data on the direct effects of technology on employment).

The Science Policy Research Unit (SPRU) of the University of Sussex has a long-standing program on technical change and employment. The group is looking at such issues as the future of employment in the services sector, the monitoring of computer-based new technology and its employment and skill implications, the impacts on women, and the social implications of information technologies. SPRU has conducted studies for the Commission of European Communities and The Organisation for Economic Cooperation and Development as well as for the U.K. Government. In 1982 SPRU prepared for the Manpower Services Commission a report entitled New Technology and Employment which estimated employment impacts of new technologies in a wide variety of sectors (19).

The Technology Monitoring Project at the University of Aston receives government support, reportedly to track all studies and reports on the impacts of technology on employment.

The Manpower Intelligence Group on New Technologies is an unstaffed committee within the Government's Manpower Services Commission (MSC) which meets periodically to review the research that has been conducted in Great Britain on the impacts of technology on employment and to recommend additional research to be supported by the MCS.

Effects of technology on employment and attitudes towards technological change:

Based on the information provided and the views of the persons interviewed, it appears that:

Technological change has had a slight negative effect on employment, especially in the manufacturing sector and has altered job skills, especially in the blue collar sector. Initially the losses occured in the semi-skilled portion of the workforce but are now occurring in the skilled crafts area. The groups considered to be especially at risk include women, who tend to be concentrated in relatively unskilled production work, and craftsmen whose skills and experience are not geared to changing job requirements (20). The 1983 survey by the Policy Studies Institute found a net direct loss of 34,000 jobs associated with the use of microelectronics in the British manufacturing industry; there were factories with an estimated increase of 20,000 new jobs and other factories with a decrease or loss of 54,000 jobs (21). This net loss of 34,000 jobs constituted about 5% of the total job loss in manufacturing employment from 1981 to 1983. The greatest decreases were in the mechanical engineering, vehicles, chemical and metals industries.

Technological change is expected to continue to have a direct negative effect on manufacturing employment, but this should be offset by gains in other sectors of the economy. Carefully hedged predictions in a 1984 study by the Department of Trade and Industry are that some 200,000 to 330,000 manufacturing jobs are likely to be displaced because of microelectronics from 1983 to the end of 1990 (22). These losses are expected to be compensated for by demand for new employment throughout the economy due to the application of the technologies. The concern was expressed that the labor force will suffer, the presumption being that labor is generally less mobile in Britain than in other countries. Thus many persons displaced might not gain employment through growth in other sectors of the economy. As Great Britain is currently not producing enough engineers and technicians to meet demands of the new information technology related jobs, many of the new positions might not be filled in the future, which would lead to a net loss in employment.

Failure to adopt new technologies rapidly has been considered a major factor in economic decline and unemployment: Many of the people interviewed believe that the main reason for job loss has been a decline in the ability of British industry to remain competitive and that rapid adoption of new computer-based production technology is necessary. Thus there appears to be a widespread perception that technological change is needed, but there is no consensus on the conditions for achieving it. In general, the way to stimulate technological change does not appear to be a particularly significant issue, although economic regeneration is indeed a major concern.

British responses to technological change:

Current British governmental policies are geared to producing greater profits for industry and to enhancing competitiveness and not especially to promoting employment. The Government's attitude seems to be the one reported in the Employment Gazette: "in the long term, the market winners will be those firms which adopt the best available practice and in many cases, this will entail adopting the new technologies. Consequently any changes in the pattern of employment associated with the adoption of new technology must to some extent be regarded as unavoidable if markets are to be kept and expanded" (23).

Compared to Sweden, Great Britain devotes relatively little attention to preparing the existing blue-collar workforce, especially semi-skilled and unskilled workers, for changes in the workplace due to technological change. However, as discussed below, it has made some significant efforts to assure an adequate supply of managerial and scientific personnel to use the new technologies.

The Microelectronics Application Program (MAP). In 1978 the Government established MAP to encourage U.K. industry to make use of microelectronics. Approximately 85 million pounds (about $100 million) were made available, to be spent over a six-year period for three types of activity: industrial awareness and manpower training to alert management to the potential of microelectronics and to assist in retraining staff to enable them to adapt to the technology; feasibility studies and consultancy support to assist industrial firms in hiring consultants to suggest ways in which corporate performance might be improved through the application of microelectronics; and microelectronics applications support, in which an eligible firm can receive a government grant paying up to 25% of the costs for corporate applications of microelectronics.

To date the Government has spent 15 million pounds (about $19 million) on the awareness and training program. Support is provided in a variety of ways. Grants covering up to 50% of development costs are made to colleges, universities, industry and professional associations, and private firms to develop courses on microelectronics primarily for practicing industrial engineers. Most courses do not exceed ten days in duration and are advanced and specialized. Many clients attend different courses at six- to twelve-month intervals (24).

Videotaped packaged learning courses have been developed for managers and engineers. MAP funds have been used by the Trade Union Congress to produce training and education programs for trade union officers and representatives. An interactive video project has been developed to retrain electricians in microelectronics.

Approximately 30,000 people a year -- less than 0.5% of the industrial workforce -- receive training under MAP-supported activities. For the most part the training appears oriented more toward professional and scientific personnel than to the skilled and semi-skilled workers whose jobs appear most threatened by technological change.

The Information Technology (IT) Skill Shortage Committee has been established by Parliament to determine demand for IT manpower at professional and technician levels over the next ten years and to estimate the extent to which the education and training system, as presently directed and funded, is likely to meet these needs (25). The Government is hoping to form a new partnership between industry and the educational community to help secure the expansion in manpower supply which industry is projected to require. The plan recommends that industry supply key executives as lecturers and university professors; enhance consultancy and employment opportunities for persons in universities to work temporarily in industry; increase loans and gifts of

equipment to educational institutions; provide increased financial aid for students; and enter into training partnerships with academic bodies. At the time of the visit, the recommendations had not been put into a form requiring government action or suggesting government incentives to help establish this new partnership.

Education and retraining: Preparation of the emerging labor force for non-professional positions is the responsibility of the Manpower Services Commission (MSC). MSC operates the Youth Training Scheme which was launched in 1983. The Scheme's objective is to provide everyone under the age of 18 with an opportunity to continue in full-time education or to enter a long-term program of training and planned work experience, including a minimum of 13 weeks of training away from the job site. Approximately 350,000 youths are participating. MSC also provides training for the unemployed, but not in substantial numbers, meeting the needs of only a small number of those out of work. In 1983/84 only 70,000 persons, or about 2% of the unemployed workforce, participated in the program (26). No data were provided on the quality of these programs for helping youths and the unemployed cope with technological change, but people interviewed implied that they were not high.

There is apparently no systematic effort to try to estimate the future needs of the workforce or to try to anticipate their training needs. Nor do there appear to be any substantial efforts to reach middle-aged workers threatened with displacement (before the displacement begins).

Training and labor market infrastructure: The MSC is focusing attention on ways to speed responsiveness of the training and education systems so that they can react more rapidly to changing labor market demands. Effort is now being devoted to determining the obstacles slowing response and determining how government resources can best be applied to provide training and manpower development programs that meet the labor market needs.

Labor union responses: The responsiveness of the labor unions to the issue varies. For example, the union representing electrical workers was reported to be aggressive in providing re-training programs to help its members respond to technological change as well as to recruit new membership. The umbrella organization for the trades unions has provided guidelines to its member organizations on the negotiation of technological agreements and reported that hundreds of agreements have been negotiated between labor and individual companies. The negotiations with labor on the introduction of new technologies are complicated by the fact that, for the most part, the workforce is organized by skills rather than by industry. Thus management in a company will likely have to negotiate with a number of unions on the introduction of new technology.

Technology Diffusion: In the last two to three years the Government has instituted some specific programs to diffuse technologies to promote improved industrial performance and, with it, more secure employment. These include Project Alvey, a 350-million pound program spread over 5 years to develop a super computer; the Innovations Program and the National Selective Assistance

scheme which provides subsidies for industrial procurement of advanced technologies; and Regional Development Grants and Regional Selective Assistance Grants to enhance competitiveness and to preserve or create new jobs.

The Work Research Unit (WRU) in the Department of Employment: The WRU, established in 1974, conducts research on ways to improve the introduction and management of new technologies, thereby minimizing their adverse impacts on employment and on labor management relations. The fourteen-member professional staff carries out research on such issues as job satisfaction measurement, human factors related to technological change, design of work and work organization (27). It publishes bibliographies on various aspects of the issue of technology and employment. The WRU provides free counselling services in specific situations where a company and its labor force are coping with some aspects of the introduction of new technologies. (There are fifteen other units with similar functions in other European countries, but this appears to have the most comprehensive charter.).

The National Economic Development Council (NEDC) is a tri-partite commission with senior representatives from labor, industry and government (ministerial level) which develops consensus approaches on how to encourage industrial growth. There are approximately 50 Committees, corresponding to specific industrial sectors. Some of these committees are dealing with issues of technology and employment and the ways to promote technological change.

Concluding Observations:

In Great Britain, the issue of technology and employment receives less attention than in Sweden and Germany. And, compared with these two countries, Great Britain appears to be doing very little to facilitate labor market adjustment to it. The Microelectronics Application Program seems to provide a variety of services helping management adapt to computer-based technologies but has not yet reached a substantial portion of the skilled and semi-skilled workforce. The periodic survey activities supported by the Government provide an excellent data base for monitoring the rate of diffusion of computer-based technology as well as the impacts of technology on employment.

TECHNOLOGICAL CHANGE AND EMPLOYMENT IN THE FEDERAL REPUBLIC OF GERMANY

Overview of the Federal Republic of Germany:

The Federal Republic of Germany (Germany), with a population of 61 million, and a workforce of almost 27 million, is the largest country in Western Europe in terms of population and probably the strongest economically. Of all the OECD Member countries, Germany has the highest proportion of its workforce engaged in the industrial sector where there is a high degree of concern about the potentially disruptive effects of computer-based manufacturing methods: 42.7% compared to 28% for the U.S. (28). Approximately 35% of the total employed workforce, and 75% of the blue collar workforce, belong to employee unions.

Germany was selected for several reasons. Germany has been extremely active among European countries in promoting the diffusion of computer-based technologies and there has been a high degree of penetration of micro-electronic/computer-based technologies in German manufacturing companies (29). Germany is a recognized world leader in some aspects of research and in the application of computer controlled manufacturing methods. There is a high level of political attention to the issue, brought about in part by a seven-week strike in the engineering industries in 1984 where a key question was the reduction of the workweek, due in part to technological progress. Eventually the workweek was shortened from 40 hours to 38.5 hours.

Special aspects of Germany:

The impacts of and responses to the issue of technology and employment in Germany appear influenced substantially by several factors. In the last two years there has been an unusually high rate of unemployment (about 8%) and little growth of the economy. Unemployment has risen from 800,000 at the start of 1980 to 2.2 million by the last quarter of 1984. There is extensive reliance on industry-run apprenticeship training programs to prepare the emerging non-professional workforce and relatively limited government involvement in youth training programs. There is a tradition of employment stability in industrial enterprises based also on national laws. Firms avoid firing workers in the event of economic downturns or when new technologies are adopted and cause a portion of the workforce to become redundant.

Attention to the issue of technology and employment:

The issue has drawn a high degree of political attention and substantial effort to determine the nature of the impacts of technology on employment. The German government supports a number of activities to monitor and assess the impacts of technology on employment. They include:

Ministry of Science and Technology (BMFT) is initiating a major study to develop and then apply a methodology for tracking the impacts of technology on employment and to develop projections of the future impacts. This will likely be, by far, the most comprehensive analytical examination in any of the European countries of the impacts of technology on employment. The methodology is expected to be developed before 1987.

Economic Research Institutions: The Government supports five independent research institutions (in Munich, Kiel, Hamburg, Berlin and Essen) to conduct research and to provide independent economic analysis and forecasting. Several have examined various aspects of the issue of technology and employment over the years, but they have come to conflicting conclusions about its impact.

Cabinet level studies: The Government has undertaken a series of studies every few years to assess among other things the macro-economic effects of technology. Although there appears to be no question that technology has contributed to economic growth, the studies are not clear as to whether this growth has resulted in direct employment loss or direct employment gain.

The debate over the accuracy and validity of the studies to date is, in part, a reason for the extensive examination being undertaken by the Ministry of Science and Technology.

Effects of technology on employment:

There is substantial debate on whether the recent adoption of computer-based technologies has led to a net loss or gain in employment throughout the economy: The general view is that it is extremely difficult to isolate the employment impacts of technology from those due to economically induced structural change, general economic weakness, changing patterns of competitiveness and the like. There have not been any widely well regarded studies about the employment impacts of new technologies in Germany. Government sources, quoting from various studies, contend that the technological change has led to increased employment throughout the economy. Yet staff from some of the economic research institutes contend that the rate of productivity growth in Germany, due in large part to the application of microelectronics, has increased more rapidly than growth in total output, resulting in employment losses and/or reduced work opportunities. Several of the persons interviewed suggested that differences in the results of the analyses depended on the political persuasion and the general economic philosophy of the organization conducting the analyses.

Technological change has had a slight negative effect on employment in the manufacturing sector. No Government studies were discussed to indicate whether there has been job loss or growth in this sector. However, results from the recently released PSI/Anglo German Foundation survey of manufacturing companies in Germany indicate that the application of microelectronics and computer-based technologies resulted in a gain of 17,000 new jobs and a loss of 47,000 jobs for a net loss of 30,000 jobs (30). Approximately 19% of all firms employing these new technologies experienced direct employment losses. Industries with the most frequent losses in employment were paper and printing, mechanical engineering and textiles.

A major question is whether continuing technological change will lead to job losses or gains: The impacts will depend on how and where the technologies are applied. The view was expressed that if the Government promotes technological change primarily to protect existing markets, it will inevitably lead to a substitution of capital for labor and a reduction in employment (though likely with increased employment security for those able to maintain their jobs in these sectors). If the Government promotes technological change more broadly to encourage applications in new sectors, it will be job-enhancing. A labor union representative expressed concern that the impacts of microelectronics in the future would lead to subsequent significant substitution of capital for labor with the likelihood that large numbers of job losses would occur.

Technological change is expected to affect job qualifications significantly: 40-50% of the jobs in the German economy are expected to change substantially as a result of the anticipated broad application by the year 2000 of new information-related technologies. This is expected to result in a drop in demand for craftsmen and for semi-skilled and unskilled workers (in such industries as metalworking) and greater demands for geographic and occupational flexibility of the workforce. A major effort, discussed briefly later, is underway to examine job qualifications in the light of technical advancements.

Attitudes toward the issue of technology and employment:

Technology and employment is considered a highly significant political issue in Germany. Representatives of Government, industry associations and organized labor consider that no labor-management relation issue is more significant than this one. Concern over the issue has probably been heightened by the long strike of the metal workers union which had substantial economic impacts and in which technology was a related issue.

"Regardless of whether technology destroys some jobs, you have to play the game (of adopting new technologies)": This view was expressed by a staff member of one of the research organizations and expressed in different terms in interviews with representatives of Government, labor and industry. Industrial performance and economic growth depend on having a technological advantage. There was no question about restraining the rate of adoption.

Rather the questions raised were: how to promote diffusion and technological change and how to share the benefits of technology with those who lose their jobs or have their working hours and work opportunities constrained because of technological advancement.

Compensation of the workforce is seen as a major issue: A strong concern of the German labor force is that technological advancement will diminish the level of skill required from much of the current skilled and semi-skilled labor force. Consequently, there will be pressures for a reduction in their wages or a substitution for lower skilled, lower paid labor. In the long run, technological change is expected to reduce the level of skills required from much of the blue-collar workforce as computer-aided automated equipment takes on more and more of the tasks now requiring high-skill level production workers. But problems arise demanding high levels of skills for short periods -- during the introduction of the new technologies, programming of the new technologies, maintenance and operations during malfunctioning. A question being raised is how to compensate the work-force when high skill levels are needed for short periods, even though lower skill levels are generally in force than were tolerated with the old technologies.

Major German Responses to Technological Change:

Education and Retraining: Germany relies heavily on an extensive apprenticeship program run by industry to train the emerging non-professional workforce. Typically, a person enters the program at age 16 and spends up to three years receiving training in the skills which the employer is seeking. As the apprenticeship programs are run directly by industry, they appear capable of changing rapidly to meeting existing or anticipated demands of industry. A substantial change in training and job skills development as a result of technical advancement has been reported in the metalworking area. There appears to be very little government involvement in or monitoring of these activities.

Promotion of microelectronics and computer-based and information-related technologies: The German government has explicitly assumed that the rapid development and industrial application of microelectronics and computer-based and information-related technologies will be key factors in determining its future competitive abilities and its employment prospects (31). Within the past two years, the Ministry for Science and Technology has developed a broad strategy of direct and indirect measures to encourage the diffusion of these technologies. The Government is placing a high priority on upgrading education in these technologies in efforts to: develop and test teaching programs leading to the integration of these technologies in the syllabus for all pupils in lower and upper secondary schools; create corresponding training and further education opportunities for teachers in these schools; and provide these schools with appropriate equipment. The Government is making available its facilities in major research institutions and industry organizations and associations are offering equipment and technical assistance. Expert conferences are being sponsored by the Federal Government to define the needed improvements and to determine the ways to achieve them.

The program is stressing improvements in vocational education. In 1984, the Federal Ministry for Education and Science initiated a pilot program with DM 20-25 million ($6-8 million) to fund 20-25 experimental vocational education activities. Recognizing that small and middle sized firms often have difficulties in retraining their workforces, the Federal Ministry for Education and Science intends to try out on an experimental basis new facilities and forms for "vocational further training" including remote learning training schemes and the development of modular training courses.

As part of the abovementioned scheme to promote microelectronics/ information technologies, the German government has established a Special Programme on the Application of Microelectronics to speed the diffusion of information technologies by supporting corporate purchase of key microelectronic or computer components. A total of DM 450 million ($140 million) has been allocated for the program. The Federal Government provides a Technological Advisory Service to assist small and medium sized firms; risk capital for technological development; general investment allowances under a "joint initiatives on jobs, growth, and stability program"; and grants to support regional development, in part through increased applications of technology

Effects of technological change on job qualifications. The Federal Government has commissioned a number of studies concerning the changes in qualifications brought about by the widespread use of microelectronics. After review of study results by industry representatives, the Federal Minister for Education and Science can incorporate appropriate amendments to qualification requirements into the Federal training regulations. The Government Employment Center at Nuremburg has a major effort underway to assess the impacts that the application of new advanced technologies as well as conventional technologies are having on job demand and job qualifications for white-collar workers. Substantial political interest has been expressed in the study and results are expected in 1985.

Humanization of Work Program: During the last ten years, the Federal Government has had a research program on the "Humanization of Work." The program has occupational safety and health research functions similar to those of the U.S. Occupational Safety and Health Administration. It also conducts research on ways to increase acceptance and to reduce the adverse impacts of new technologies in the workplace. Program expenditures for 1985 are expected to be 90 million DM (about $25 million). The program funds pilot projects on innovative approaches for introducing new technologies to minimize adverse labor impacts. It has also supported research leading to the development of training programs to upgrade the skills of operators so that they not only use the new technologies but also perform maintenance and repair functions. Priority areas relating to the issue of technology and employment include: application of new technologies in accordance with human needs, organizational change and development of new skills to reduce the impacts of office automation, avoidance of adverse effects on jobs of the utilization of robots.

Over the years the program has worked extensively with industry and with trades unions to disseminate and help implement research findings (32).

The program has supported research on the introduction and use of new technologies in industrial settings in Germany, France, and elsewhere. Findings indicate that the way in which management introduces the new technology and applies and integrates it with the workforce and other corporate resources is perhaps the major factor in determining how the technology affects skill demands as well as its impacts on employment, at least to a certain degree. The conclusion reported by someone responsible for much of the research is that a given technology does not arbitrarily impose a given set of impacts on the mix of skills. Technological change can be integrated within the existing labor market with minimal disruption (33).

Reduction in the Work Week/Early Retirement: To help combat the high rate of unemployment and to help settle the previously mentioned labor dispute, the Government recently adopted legislation facilitating early retirement and reduction in the workweek as a means of spreading jobs and as a partial response to reductions in direct employment due to technological change. The legislation leaves to the company and its organized labor force the negotiation of agreements for early retirement or for reductions in working time.

Concluding Observations:

The monitoring and tracking system to quantify the impacts of technological change on employment, findings from the on-going job qualifications studies, and the pilot projects on education, vocational training and "re-training" are likely to be appropriate or transferrable to the United States. The U.S. might want to examine these developments in 1986.

SUMMARY AND COMPARISON OF FINDINGS FROM THE THREE COUNTRIES

National attitudes towards the issue:

The extent of national concern and the commitment to respond to the issue of technology and employment varies among the countries. Sweden has shown the highest degree of concern about the societal impacts of the issue and a high level of receptivity to anticipating technological change and adopting programs to facilitate labor market adjustment before the event. The Federal Government of Germany has a high degree of concern about the need to promote technological change to maintain competitiveness and economic vitality and has the most extensive programs to promote the diffusion of new technologies. Great Britain has a high degree of recognition of the need for broad adoption of the new technologies but a lesser degree of concern about trying to anticipate impacts and prepare the labor force in advance to minimize impacts.

All three countries consider a rapid rate of adoption and diffusion of the new technologies essential for supporting economic growth and for securing employment for a substantial proportion of the workforce. "You have to play the game of adopting technology rapidly, even if it results in some direct job loss." None of the countries appears to have adopted policies to moderate or to impede the rate of diffusion of new technologies.

Within Sweden and Germany, there is a widely shared view that the extent of job loss and the impacts on employment levels, skill demands and the nature of work are greatly influenced by the ways in which management prepares the labor force for the new technologies, introduces the technologies, and applies the technologies. Technological change need not automatically result in de-skilling or substantial dislocation of the workforce. These two countries have devoted substantial attention to working with industry in the development of experimental approaches for introducing new technologies to minimize their impacts on the labor force.

Organized labor recognizes the need for a rapid rate of adoption of the new technologies, even though it will likely have some detrimental impacts on a portion of its membership. It was particularly concerned about how to share the benefits of technical change.

Monitoring and assessment efforts:

All three countries have significant assessment and monitoring activities, though the thrusts of the efforts vary. Sweden's approach emphasizes qualitative assessment using Government commissions with very broad representation to estimate the impacts and to identify the implications for government policies; the Federal Government of Germany supports a number of efforts within a network of economic institutes as well as within the government to assess the impacts; Great Britain supports direct surveys by a private organization to determine direct job loss from the application of microelectronics and computer-based equipment within the manufacturing sector.

Impacts to date:

Technological change has caused some direct job loss in those industries applying it, but the countries have found it extremely difficult to isolate the extent of job loss due to the introduction of the new technologies from those due to structural change, general economic weakness throughout much of Europe, and changing market conditions and competitive relationships. Recent work suggests that at least in Germany and Great Britain the extent of direct job loss in the manufacturing sector due to the application of microelectronics technologies has been relatively slight, compared to losses from other factors.

Technological change has contributed significantly to overall economic growth, but there were differences in opinions among the countries as to whether the change has resulted in increased employment throughout the economy. In Great Britain, there is a widespread view that a substantial amount of its industrial economic difficulties and employment losses have been due to a failure to adopt technology readily in the recent past.

Technological change significantly affects certain skill groups and job qualifications. Those most affected have been the semi-skilled blue collar workers and lower level clerical workers. As the diffusion of the new technologies becomes more extensive, the skilled crafts workers are expected to be substantially affected. The group of greatest concern and the group seen as having the greatest difficulties coping with technological change are the mid-career blue collar workers, especially those in industries expected to contract.

In Great Britain and Germany microelectronics and computer-based equipment have caused employment losses most often in mechnanical engineering, chemicals, vehicle construction and printing industries. Comparable data were not available from Sweden.

Expected impacts:

The present extent of the use of the new technologies is considered to be relatively small, compared to its potential applications and the expected continuing rapid rate of advancement of the capabilities of the technologies. The impacts are expected to grow as the technologies become more broadly diffused and employed in a much wider range of ways. The net employment impacts throughout these economies appear almost impossible to predict reliably. Net impacts will be influenced by the extent to which the technology is applied to upgrading existing manufacturing processes, which would tend to reduce employment, and the extent to which technology is applied to creating new services or products, which would tend to increase the number of jobs. The consensus in all three countries seems to be that employment levels in production positions in the manufacturing sector will shrink with the wider use of the new technologies (though total industrial employment might not shrink because of offsetting growth in service-related jobs in this sector).

Persons interviewed in all three countries expect continued growth both in the number of persons unemployed due to technological change and in unfilled jobs because of an insufficient number of persons with the appropriate skills to use the new technologies.

In all three countries there are strong feelings that continuing technological advancements and the inevitably more extensive application of new technologies will increase demands for labor market flexibility. A large portion of the workforce, estimated to range from 30% to perhaps 50%, will have to change their skills and perhaps occupations one or more times during their working careers.

Responses to technical change:

All three countries have innovative programs for dealing with technological change, either to assist labor market adjustment or to promote technological diffusion, in part as a means of securing employment. Programs which may be of special interest to the United States are:

Sweden: Extensive efforts to train the workforce and the population at large on the uses and applications of computers; two experimental programs providing government funds for industry and labor to attempt innovative approaches for training the workforce to use the new technologies and for introducing the technologies with minimum adverse impacts; and the Renewal Fund in which 10% of the profits of individual companies from 1984 have been set aside, with labor and management to decide jointly how the funds will be used for research or training to enhance corporate performance and to promote more secure employment of the company's workforce. The Parliament was considering an extensive array of programs recommended by a commission that spent six years examining the issue of the impacts of computers on employment and society; one of the proposals would provide funds for re-education and re-training of persons currently employed in industries judged by the National Labour Market Board as likely to contract.

Great Britain: The Government's Microelectronics Applications Project to encourage widespread industrial applications of microelectronics and to provide a wide variety of training courses for engineers and technicians; the Information Technology Skills Shortage Committee, which is trying to develop a joint educational-community-industry program to meet industry's professional and technical manpower needs in computers and information technologies; a periodic surveying activity to track the rate of industrial diffusion of computer-based technology and the direct employment impacts of the adoption of computer-based manufacturing technologies on jobs in the manufacturing sector; the Work Research Unit which conducts research on a variety of labor management aspects of technology, especially those related to the introduction of new technologies.

Germany: An extensive national program to promote information technology that calls for widespread computer-related education of the emerging workforce and pilot projects to develop vocational retraining mechanisms for the existing workforce; development of a methodology for assessing the impacts of technology; jobs qualification study to determine the impacts of technology on skill demands; the Humanization of Work program to conduct research and to support pilot projects to reduce the adverse impacts of the introduction of new technologies in the workplace.

The countries have programs to provide information on job opportunities on a nationwide basis and programs to facilitate relocation and geographic mobility of the workforce. As only a relatively small portion of the unemployed workforce takes part in these programs, they do not appear to be especially effective major responses to unemployment, whether due to technological change or to other causes.

Common Problems:

There were common problems faced by the three countries which appear similar to those perceived in the United States and where cooperative research and sharing of experiences would seem appropriate.

Mid-career blue collar workers threatened with dislocation: How to provide training to persons in industries or corporations likely to shrink and where there is no corporate/industry incentive or ability to retrain the workers.

Computer-related training of the future workforce: All three countries recognize that substantial modifications are needed in the upper and lower secondary education systems for students receiving general training and vocational training, but no consensus has as yet appeared on the types of training needed.

Gap between unemployed and unfilled positions: Some of the persons interviewed anticipate increases in both the number of persons unemployed and the number of jobs that go unfilled because of a shortage of people with appropriate skills.

Ways to introduce new technologies to minimize their labor market impacts: Industries have used a variety of approaches to minimize the impacts of the introduction of new technologies. Interest was expressed in an identification and evaluation of these programs.

Training of the managerial workforce. The labor market impacts of new technologies as well as their corporate success depend heavily upon the skills of the management force in industry. There might be incentives or support that governments can provide to upgrade management training/retraining.

Methodological problems in monitoring impacts: There are substantial problems both in terms of how to assess the impacts to date of the technology on employment and of job qualifications. Projections for the future to help anticipate problems are even more difficult.

NOTES AND REFERENCES

1. Source: Quarterly Labour Force Statistics, No 1, 1985, OECD, Paris. Standardized unemployment rates for other countries were: France 10.1%; Belgium 13.9%; Finland 6.2%; Netherlands 13.2%; Spain 21.2%; Switzerland 1.0%; Sweden 3.0%; Great Britain 13.4%; and Federal Republic of Germany 8.0%. These figures were standardized for direct comparisons by OECD.

2. Northcott, J., with P. Rogers, Knetsch, and de Lestapis, Microelectronics in Industry: An International Comparison: Britain, Germany, France; Policy Studies Institute and the Anglo-German Foundation, London, 1985.

3. Office of the Prime Minister, Economic and Social Affairs Department, Ref.: International Conference on Technology and Employment, Rome, 20 December 1984.

4. The Report of the Finnish Technology Committee, Planning Department of the Office of the Prime Minister of Finland, Helsinki, 1982.

5. Scientific and Technological Development and its Effects on Employment and Working Conditions, MTV-HF 3(84)6, Council of Europe, Strasbourg, 20 December 1984.

6. Among the titles published by FAST on this topic are: The Future of Service Employment in Europe, New Information Technology and Women's Employment, and Information Technology and Job Creation Potential, Synthesis of Specific Studies: Conclusions and Recommendations.

7. FAST 1984-1987: Objectives and Work Programme, Commission of the European Communities, Brussells, February, 1984.

8. Technological Change and Social Adjustment, (Commission Communication to the Council) COM(84) 6 final, Commission of the European Communities, Brussells, 26 January 1984.

9. Employment Growth and Structural Change, OECD, Paris, 1985.

10. This is a Background Paper to the meeting and is entitled "Work Related to Employment and Technology." It is expected that the paper will be published by the Italian Government as part of the Conference Proceedings.

11. "Technology and Employment: Draft Synthesis Report," Directorate for Science, Technology and Industry, OECD, Paris, January, 1985.

12. Attenborough, N.G. Employment and Technical Change: The Case of Microelectronic-Based Production Technologies in UK Manufacturing Industry, Government Economic Service Working Paper No 74, Department of Trade and Industry, London, 1984. Table 3, p. 12, contains data on the diffusion of industrial robots. The data were drawn from Main Economic Indicators, OECD, January 1984.

13. According to an OECD report, Economic Survey: 1983-84: Sweden, in 1982 approximately one half of the unemployed labor force was in "hidden unemployment" -- relief work, vocational training and sheltered employment and not counted in official unemployment statistics. The open plus hidden employment was 6.5% of the labor force in 1982 and 7.5% in 1984.

14. Agreement on Efficiency and Participation: SAF-LO-PTK, Swedish Employers Confederation, Stockholm, 1982.

15. These recommendations are taken from Computers and Changes in Working Life: Summary of the Final Report from the Commission on the Effects of Computerization on Employment and Working Environment, Ministry of Labour, Stockholm, 1984. Translated titles of other published reports include: "Industrial Computerization -- Effects on Employment and Working Environment," "Computers and Changes in Working Life," and "Effects of New Technology on Productivity, Employment and Working Hours." Translated titles of books published include: Better or Worse with Computers? Five Worksites and Problems of Computerization; Jobs in the Future? Thoughts about Industrial Work in the Computer Society of the 1990's; and Female Jobs in the Future? About Office Automation and Women's Future Labour Market.

16. Several countries in Europe are giving serious consideration to national networks of computer learning facilities. The Government of France is proceeding with a program to purchase 150,000 to 200,000 computers to be installed in public buildings throughout France. These computers will be available for everyone. Some types of instruction and assistance will be provided. Apple was considered to be the initial choice of the French government until domestic considerations prevailed.

17. Northcott, J., with P. Rogers, Microelectronics in Industry: What's Happening in Britain, Policy Studies Institute, London, March 1982, and Northcott, J., with P. Rogers, Microelectronics in Industry: The Pattern of Change, Policy Studies Institute, London, March 1984.

18. Northcott, J., with Rogers, Knetsch and de Lestapis, op. cit.

19. Braun, E. and P. Senker, New Technology and Employment, Manpower Services Commission, London, 1982. The conclusions of the report are so carefully hedged that it is difficult to summarize any striking conclusions.

20. Attenborough, op. cit.

21. Northcott with Rogers, 1984, op. cit. This survey measured job loss and job gain by those persons directly responsible for using the microelectronics equipment. It did not measure changes in sales or support staff. Northcott thinks that the survey underestimated the total employment gains.

22. Attenborough, op. cit.

23. Williams, Virginia, "Employment Implications of New Technology," Employment Gazette, May, 1984, pgs 210-215.

24. The Depar tment of Trade and Industry, "The Microelectronics Application Project (MAP) Training," February 1985. The Department has published dozens of brochures and catalogues describing specific courses available and projects supported with MAP funds.

25. IT Skills Shortages Committee, First Report: The Human Factor - The Supply Side Problem, Department of Trade and Industry, London, 1984.

26. Data taken from Annual Report 83/84, Manpower Services Commission, Sheffield, August, 1984.

27. "Summary of Publications," Work Research Unit, Department of Employment, London, October, 1984.

28. OECD, Quarterly Labour Force Statistics, N° 1, 1985.

29. Northcott with Rogers, et al., found that Germany had a higher rate of use of microelectronics in factories than Britain and France. The respective rates were: 50.5%, 46.9% and 38.1%.

30. Ibid.

31. A translation of the German scheme has been published by the Commission of the European Communities. Government Report on Information Technology: Federal Government Scheme to Promote the Development of Microelectronics and the Information and Communication Technologies; Status: 23 February 1984.

32. Some of the material has been translated into English. "Programme Research on the Humanization of Work: Report of the Federal Government on Planning further Development of the Program," Federal Minister for Research and Technology; Bonn, April 1983. Also, "Programme Research on the Humanization of Work: Interaction Between 'Humanization of Work' and Innovation," Federal Minister for Research and Technology, Bonn, August 1984.

33. The leader of the research in Germany on the humanization of work and ways to introduce technology without disrupting the skills-structure is probably Dr. Burkhard Lutz of the Institut Fuer Sozialwissenschaftliche Forschung in Munich.

APPENDIX 1: ORGANIZATIONS VISITED

SWEDEN: January 14 and 15, 1985:

Swedish Trade Union Confederation, LO
Central Organization of Salaried Employees, TCO
Institute of Social Research
Swedish Employers Confederation, SAF
Data Policy Committee
Swedish Center for Working Life
Ministry of Labour
Ministry of Industry

Great Britain: January 24 and 25, 1985:

Manpower Services Commission
Department of Trade and Industry
Department of Employment
Work Research Unit
National Economic Development Office
Trade Union Congress

Federal Republic of Germany: January 28-30, 1985

IFO-Instituts fuer Wirtschaftsforschung, Munich
Institut fuer Sozialwissenschaftliche Forschung, Munich
Bundesministef fuer Forschung und Technologie, Bonn
Bundesminister fuer Wirtschaft, Bonn-Duisdorf
Bundesminister fuer Arbeit und Sozialordnung, Bonn-Duisdorf
Gespraeche mit Arbeitgeberorganisationen, Cologne
Gespraech Beim Duetschen Gewerkschaftsbund, Dusseldorf.